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Radiographic Examination of a 'Mayfly' Charge

A. Mendoza

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Waltham Abbey
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March
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Radiographic Examination of a 'Mayfly' Charge

by

A. Mendoza

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1. SUMMARY

A radiographic technique has been developed for examining an 8.6-inch diameter, star centred, extruded propellant charge for 'Mayfly'. By suitably orientating the charge, a reasonably uniform optical density can be obtained across the film. Three radiographs taken in directions 120 degrees apart permit a thorough examination of a length of charge.

Ilford Industrial 'C' X-ray film was exposed to 140 kV for 27 mA.minutes, using a front lead screen 0.004 inch thick, and 0.030 inch thick back lead screen.

2. INTRODUCTION

A cordite charge for 'Mayfly', 8.6 inches diameter, star centred, and 120 inches long, was extruded through a 'long-parallel' die fitted to a $10\frac{1}{2}$-inch horizontal press at E.R.D.E., Woolwich.

Investigations have been carried out at E.R.D.E., Waltham Abbey, to determine and apply a radiographic technique for the examination of this charge.

3. EXPERIMENTAL

The cross-section of the charge is shown in Fig.1. A first attempt was made to radiograph the charge set up as in Fig.1, but it was found to be impossible to examine the cross-section satisfactorily in one exposure, as the spread in optical density across the film hindered interpretation. The thickness of propellant along AA is 6 inches, compared with 2.6 inches along BB, so that adequate penetration through AA would over-expose the film under BB, whilst if BB is radiographed satisfactorily AA is not penetrated. Fig.2 is a print from a radiograph exposed with the arrangement of Fig.1, showing the undesirable range of optical density. Additional radiographs were then obtained after rotating the charge through 15 degrees from its position in Fig.1, so that the differences in thickness of propellant to be penetrated were not so great, and interpretation of the radiographs was much facilitated.

Ilford Industrial 'C' X-ray film was used between lead screens, 0.004 inch in front and 0.030 inch behind, with a film focus distance of 36 inches. At 140kV it was found that an exposure time of 27 mA.minutes was adequate.

With the charge in its new position (Fig.3) further films were exposed to investigate detection of flaws in two extreme positions in the charge, with a penetrameter at 'a' or 'b' of Fig.3. This device is designed for use with a quarter-inch of steel and is not ideal for colloidal propellant (E.R.D.E. Technical Memorandum No.15/M/53). Fig.4 is a print from the radiograph obtained with the penetrameter at 'a', and Fig.5 is a print showing the penetrameter at 'b'. The radiographic techniques were identical for these two exposures.

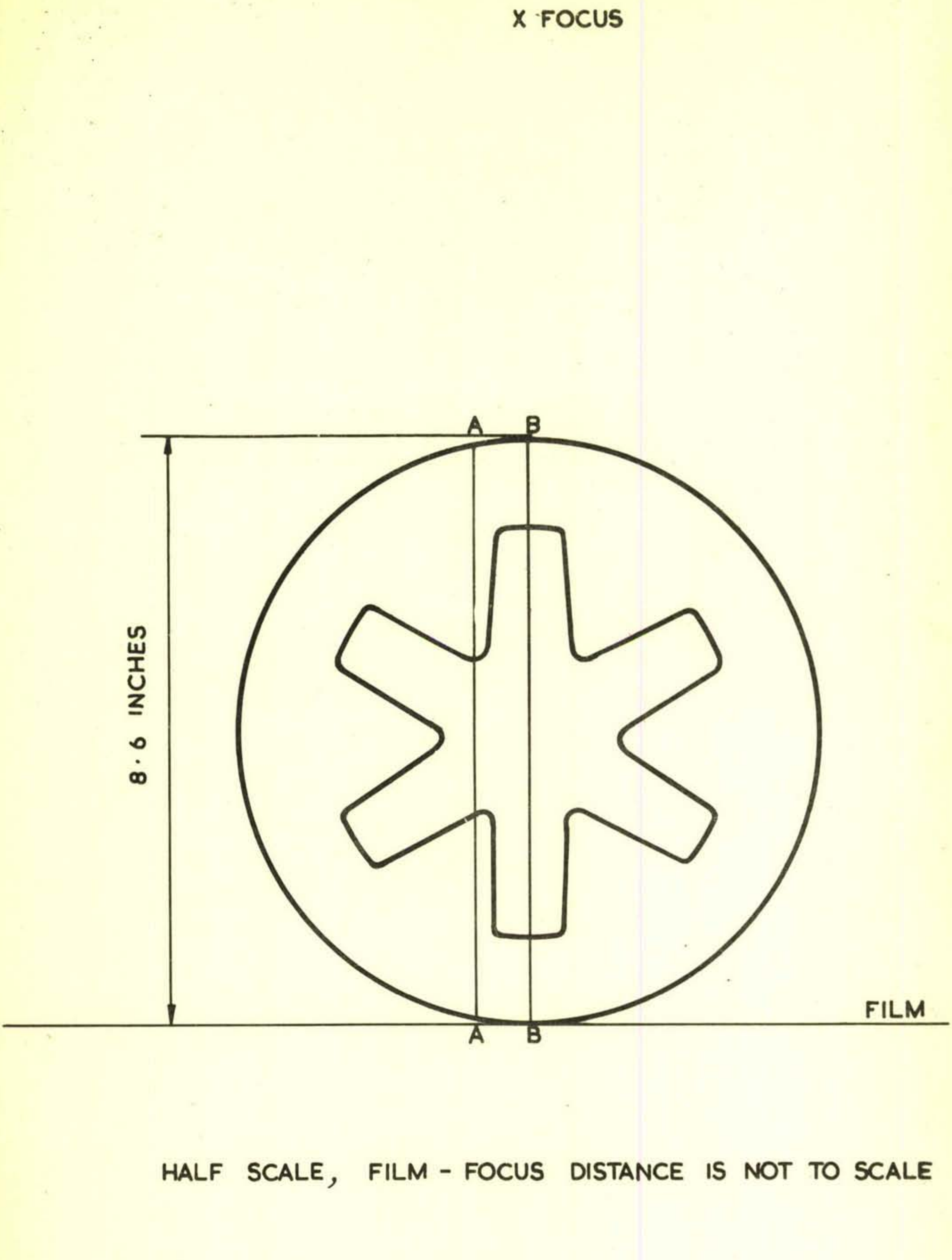
The difference in definition of the penetrameter in Figs. 4 and 5 is marked, and obviously minute faults in the upper half of the charge would not be well defined on the radiograph. Consequently, each section of the charge was radiographed in three positions, along the X, Y and Z lines, Fig.6, turning the charge through 120 degrees after each exposure. The examination of the charge by this method ensured that each part of the cross-section was adjacent to the film in one of the three positions.

/Figs.7, 8 and 9

Figs. 7, 8 and 9 are prints from three radiographs of one section of the charge, exposed in the X, Y and Z orientations. Fig.7, printed from the radiograph exposed in orientation X, shows images of two groups of flaws. Group S shows up sharply, but Group T is not well defined. Fig.8, from the Y orientation, shows both groups of flaws poorly defined, and Fig.9 from the Z orientation, shows Group T well defined and Group S again poorly defined. Hence it is seen that each group of flaws is well defined in one radiograph of the three, and the desirability of radiography in the three orientations is confirmed.

4. CONCLUSION

This work gives reason to believe that, in general, it will be possible to radiograph any charge of reasonable web thickness, and elementary cross section, if a series of orientations can be found such that substantially equal thicknesses of material are presented to the X-ray beam.



HALF SCALE, FILM - FOCUS DISTANCE IS NOT TO SCALE

FIG. 1.

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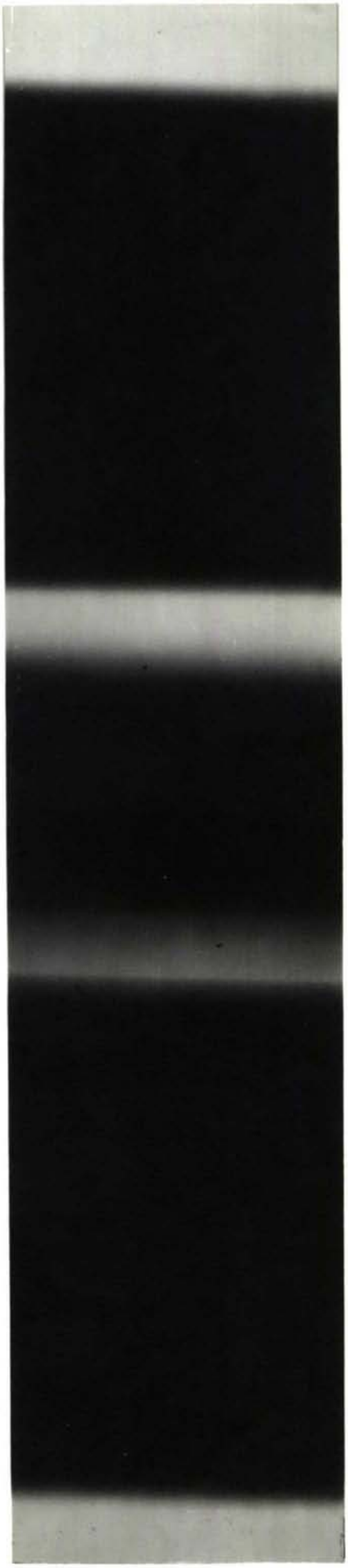

FIG. 2.

X FOCUS

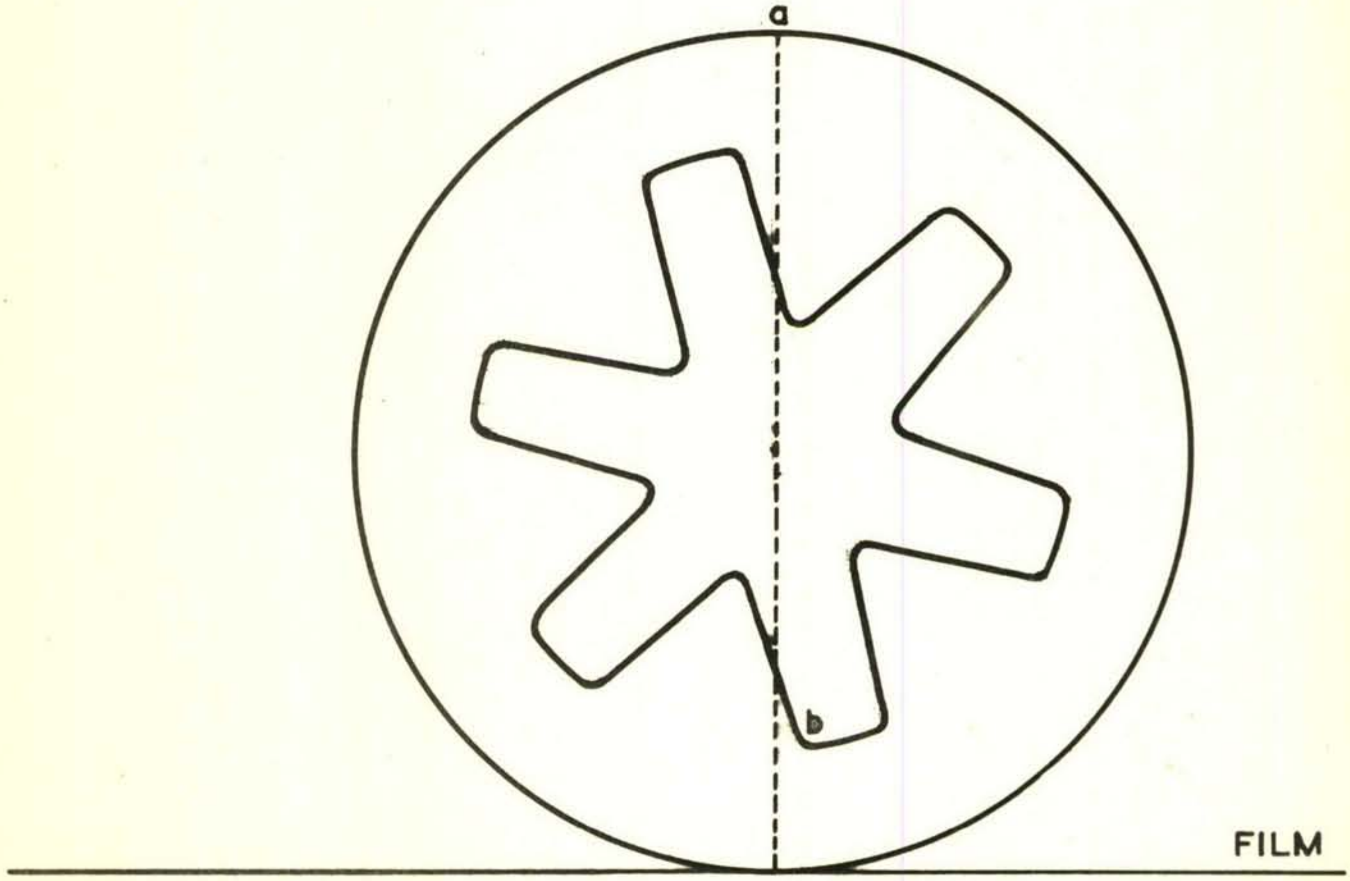

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FIG. 3.

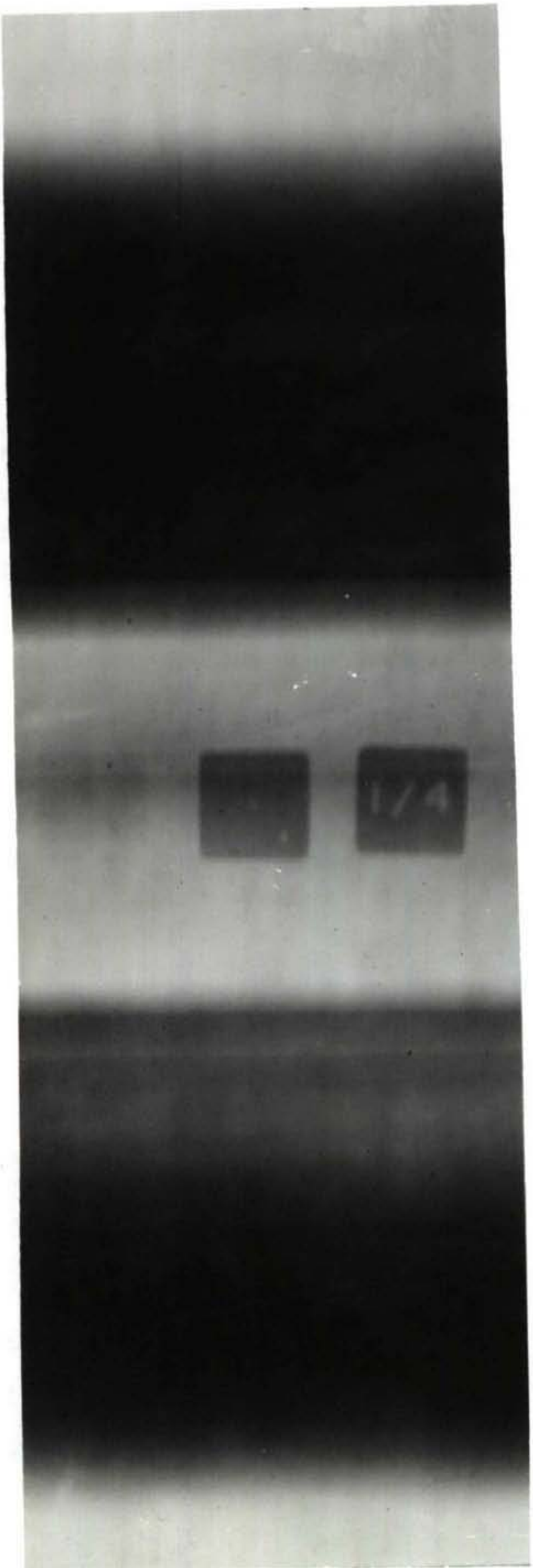


FIG. 4.

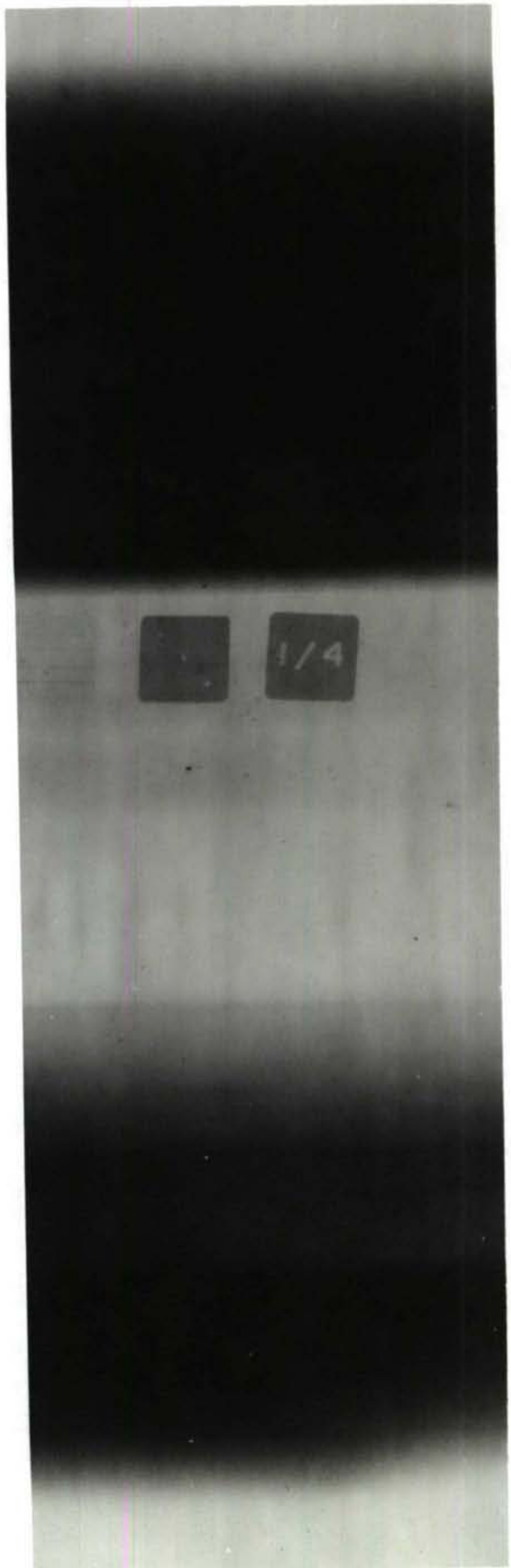
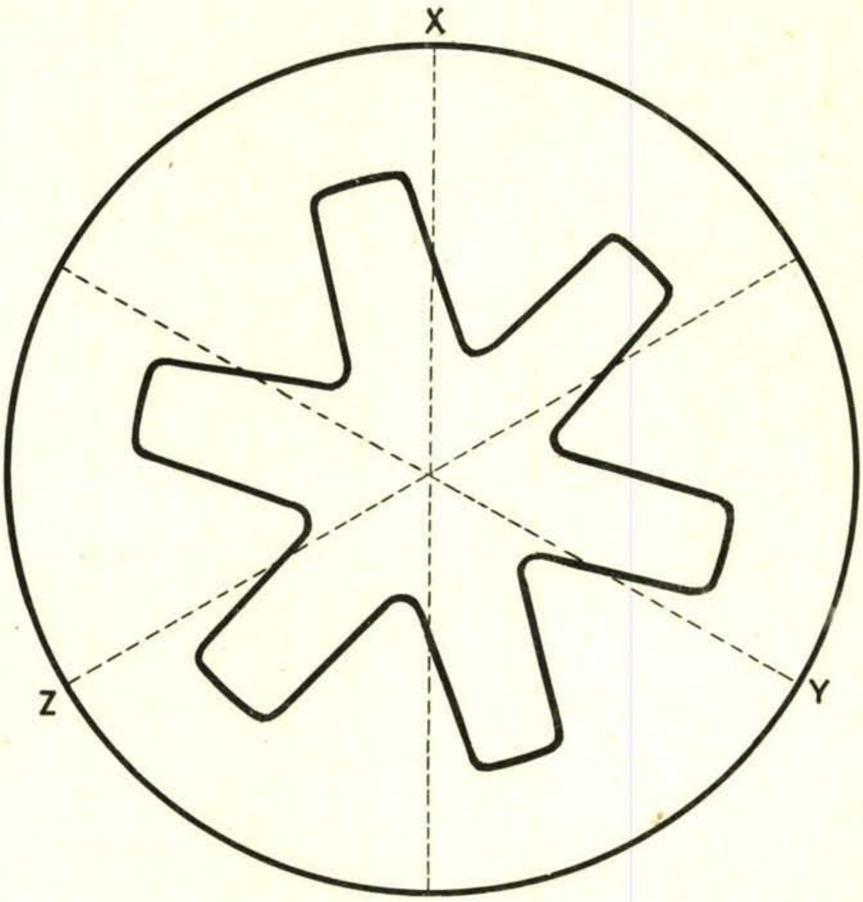


FIG. 5.



HALF SCALE.

FIG. 6

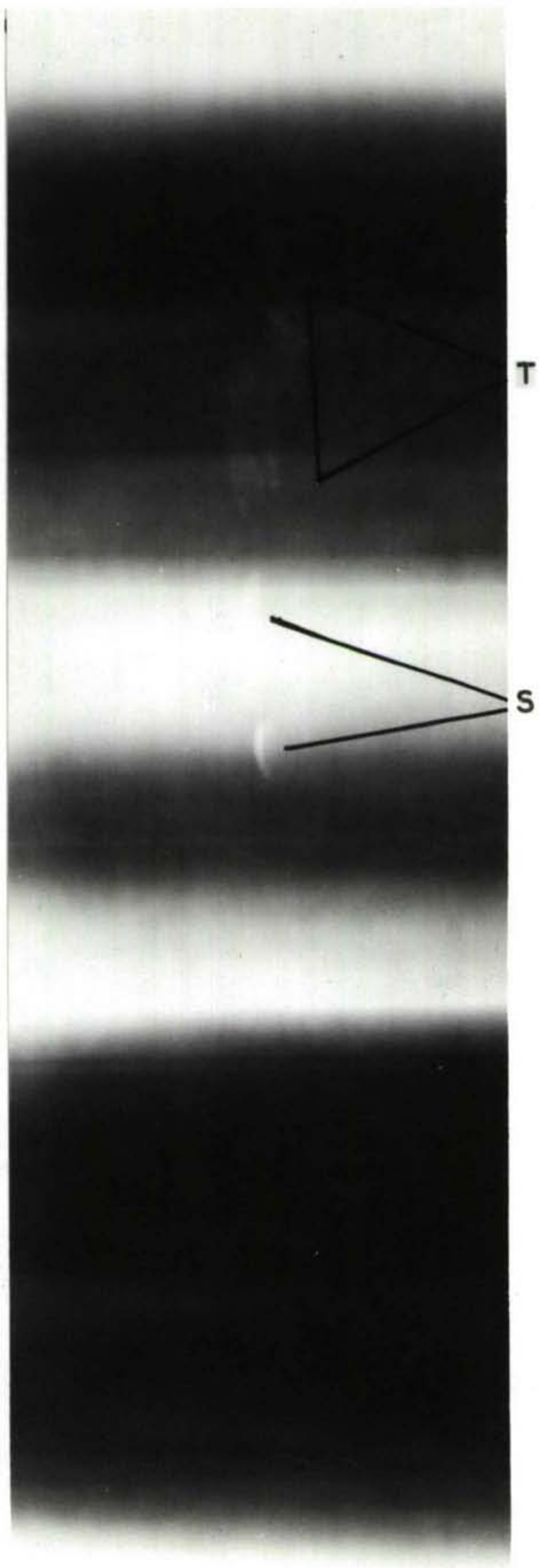


FIG. 7

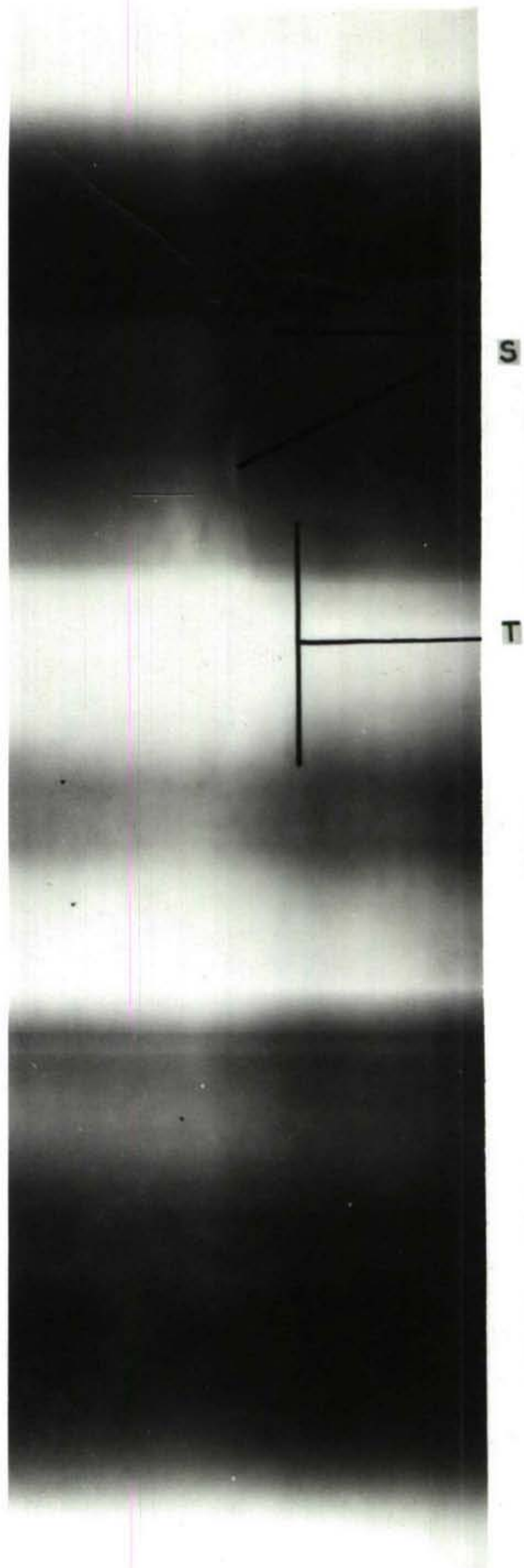


FIG. 8

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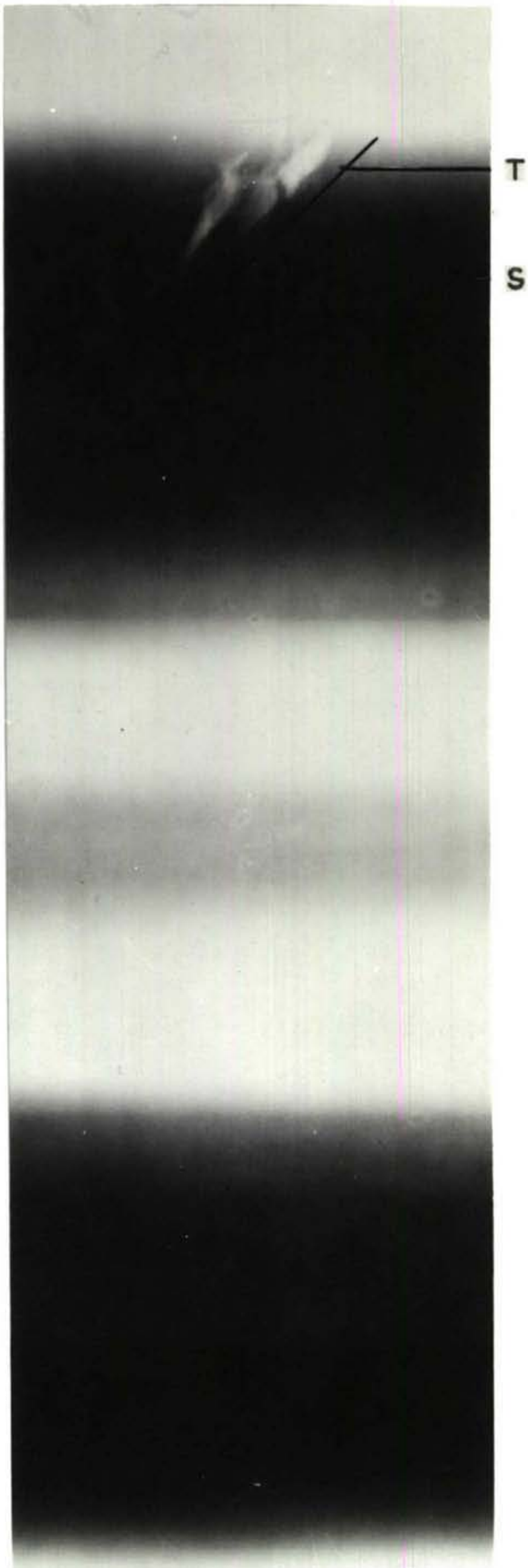

FIG. 9

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